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Gas turbine combustion chamber

The invention relates to a gas turbine combustion chamber with a manhole as access to a combustion chamber interior, which may be sealed with a manhole cover.

Gas turbines are used in many fields for driving generators or machines. The energy content of a fuel is thereby used to generate a rotational movement of a turbine shaft. For this purpose, the fuel is combusted in a combustion chamber, with compressed air being supplied by an air compressor. The operating medium which is generated in the combustion chamber by fuel combustion, and which is subject to high pressure and to high temperature, is thereby fed via one of the turbine units arranged downstream of the combustion chamber, where it expands in a productive fashion.

In addition to the output which can be achieved, the design purpose of this type of gas turbine is generally to achieve a particularly high degree of efficiency. For thermodynamic reasons, an increase in the degree of efficiency can essentially be achieved by increasing the discharge temperature, at which the operating medium flows out of the combustion chamber and into the turbine unit. The aim is therefore to reach temperatures of around 1200 °C to 1300 °C for gas turbines of this nature, said temperatures being achieved.

A combustion chamber exposed to these temperatures when operating the gas turbine should be internally accessible, for inspection purposes for instance. DE 199 24 607 A1 discloses a gas turbine with a combustion chamber comprising at least one sub-area which can be examined by means of manhole access. DE 198 09 568 A1 discloses a gas turbine with an annular combustion chamber, access (a manhole) being provided in the flame chamber, by means of which a person can enter the flame chamber. However a manhole in the combustion chamber is frequently dispensed with, particularly in gas turbines with high

combustion temperatures of 1200 °C to 1300 °C, since it would not withstand the thermal loading prevalent therein, or could not guarantee at least the leak-tightness of the combustion chamber. This is particularly the case with combustion chambers equipped with combustion chamber liners. Extremely costly de-installation work is necessary in order to allow a person entry into the combustion chamber.

The object of the invention is to specify a gas turbine combustion chamber, which is suitable for a gas turbine with a particularly high combustion temperature and enables a person to enter with ease.

This object is achieved according to the invention by means of a gas turbine combustion chamber with the features of Claim 1. The gas turbine combustion chamber thereby has a manhole as access to a combustion chamber interior, which can be sealed with a manhole cover, said manhole cover having an inner cooling chamber. The inner cooling chamber, in other words the cooling chamber within the manhole cover, enables specific cooling of the manhole cover sealing the combustion chamber interior. The manhole cover can thus also be used in the combustion chamber interior when subject to high thermal loading, without deforming to an impermissible degree. Leak-tight sealing of the combustion chamber interior is guaranteed in all operating states by means of the manhole cover.

In addition to the manhole cover, it is preferable that the combustion chamber wall can be internally cooled in at least one area of the gas turbine combustion chamber with a particularly high level of thermal loading.. The combustion chamber wall thereby comprises what is known as a wall cooling chamber. The inner cooling chamber of the manhole cover can preferably be connected for fluid flow purposes to the wall cooling chamber of the combustion chamber wall, by means of connecting lines for example. Thus at least similar thermal conditions can be produced in a simple manner at the different components enclosing the

combustion chamber interior, in particular the manhole cover and the combustion chamber wall surrounding it.

A connection for fluid flow purposes between the inner cooling chamber of the manhole cover and the wall cooling chamber of the combustion chamber wall can be produced directly according to a preferred embodiment in a particularly simple manner by inserting the manhole cover into the manhole. It is thus possible in particular for the transition to be made between the wall cooling chamber of the combustion chamber wall and the inner cooling chamber of the manhole cover without any cross-sectional reduction. The whole wall of the gas turbine combustion chamber including the manhole cover preferably forms a homogenous cooling chamber.

According to a preferred embodiment, the manhole cover or at least one cover element of the man hole cover, a cover liner for instance, which seals off the inner cooling chamber of the manhole cover from the combustion chamber interior, is supported by means of a fixing element against the combustion chamber interior, with this fixing element also holding a liner element adjacent to the manhole cover against the combustion chamber wall. This multifunctionality of the fixing element allows the number of fixing elements in the combustion chamber to be minimised.

The cross-section of the fixing element is preferably at least essentially U-shaped, with a first side of the U supporting the cover element of the manhole cover and a second side of the U holding a liner element against the combustion chamber wall. The complete fixing element is preferably in the form of a rail. The U-shaped configuration of the fixing element allows both adequate stability and elasticity.

The fixing element is preferably held against the combustion chamber wall such that an element, in particular a side of the U, of the fixing

element projects into the manhole and supports the cover liner of the manhole cover against the combustion chamber interior there, and the manhole cover can be removed from the manhole without releasing the fixing element. This is advantageous in that all fixing elements, which hold both the liner elements and the cover liner against the combustion chamber wall and/or the manhole cover, only have to be attached once and entry into the gas turbine combustion chamber is possible through the manhole without having to remove one of these fixing elements.

The advantage of the invention lies particularly in the fact that the manhole cover withstands a high level of thermal loading as a result of an inner cooling chamber, with extremely simple removal of the manhole cover, including its inner cooling chamber, being enabled by the manhole.

An exemplary embodiment of the invention is described in more detail below with reference to a drawing, in which;

Figure 1 shows a half section through a gas turbine
Figure 2 shows a partial cross-sectional view of the gas turbine combustion chamber of the gas turbine according to Figure 1.

Identical parts are provided with the same reference characters in both figures.

The gas turbine 1 according to Figure 1 has a compressor 2 for combustion air, a combustion chamber or a gas turbine combustion chamber 4 and a turbine 6 for driving the compressor 2 and a generator (not shown) or a machine. To this end, the turbine 6 and the compressor 2 are arranged on a common turbine shaft 8 known as a turbine rotor, to which the generator and/or the machine are also connected, and which is supported such that it can be rotated about its center axis 9.

The combustion chamber 4 is equipped with a number of burners 10 for combusting a liquid or a gaseous fuel. Furthermore liner elements 25 are provided on its interior wall or combustion chamber wall 23.

The turbine 6 comprises a number of rotatable blades 12 connected to the turbine shaft 8. The blades 12 are arranged in a ring shape on the turbine shaft 8, thus forming a number of rows of blades. The turbine 6 further comprises a number of fixed vanes 14 which are attached in a similar ring shape to an interior housing 16 of the turbine 6, forming rows of vanes. The blades 12 thereby serve to drive the turbine shaft 8 by transmitting impulses from the operating medium M flowing through the turbine 6. In contrast, the vanes 14 serve to guide the flow of the operating medium M between two consecutive rows of blades or rings of blades respectively, when viewed in the flow direction of the operating medium M. A consecutive pair comprising a ring of vanes 14 or a row of vanes and a ring of blades 12 or a row of blades 15 is thereby also referred to as a turbine stage.

Each vane 14 also has a platform 18 which is also referred to as the vane base 19, which is arranged on the interior housing 16 of the turbine 6 as a wall element to fix the respective vane 14. The platform 18 is thereby a component which is subject to comparatively heavily thermal loading, forming the external boundary of a hot gas channel for the operating medium M flowing through the turbine 6. Each blade 12 is attached to the turbine shaft 8 in a similar manner, by means of a blade base 19 also referred to as a platform 18, with each blade base 19 supporting an extended, profiled paddle 20 along a blade axis.

A guide ring 21 is arranged on the inner housing 16 of the turbine 6 between the platforms 18 of the vanes 14 of two adjacent rows of vanes arranged at a distance from one another. The external surface of each guide ring 21 is thereby similarly exposed to the hot, operating medium

M flowing through the turbine 6 and is separated from the external end 22 of the opposite blade 12 by a gap in the radial direction. The guide rings 21 arranged between adjacent rows of vanes thus serve particularly as covering elements, which protect the inner wall 16 or other housing assembly elements from thermal overload due to the hot operating medium M flowing through the turbine 6.

To achieve a comparatively high degree of efficiency, the gas turbine 1 is designed for a comparatively high discharge temperature of approximately 1200 °C to 1300 °C for the operating medium M leaving the combustion chamber 4. The combustion chamber wall 23 is cooled internally to enable this. Combustion air thereby flows counter to the operating medium M, in other words the combustion gases, between the combustion chamber wall 23 and the liner elements 25 attached to said wall and surrounding the combustion chamber interior 24 through a wall cooling chamber 26 to the burners 10. This combustion chamber cooling intentionally allows the combustion air to be heated at the same time.

Figure 2 shows a partial cross-section of the combustion chamber wall 23 with a manhole 27, into which a manhole cover 28 is inserted. The manhole cover 28 has a cover upper section 29 which is configured in a similar manner to the combustion chamber wall 23, and a cover liner 30. An inner cooling chamber 31 of the manhole cover 27 is enclosed between the cover upper section 29 and the cover liner 30, which are also referred to as cover elements respectively. A wall cooling chamber 26 is correspondingly enclosed between the combustion chamber wall 23 and a liner element 25 attached to this. The inner cooling chamber 31 of the manhole cover 27 is connected to the wall cooling chamber 26 of the combustion chamber wall 23 such that the combustion air can flow unhindered, perpendicular to the plane shown.

The cover upper section 29 has a projection 33 at its edge, by means of which it can be inserted into a corresponding retaining indentation 34 in the combustion chamber wall 23. The manhole cover 28 essentially

has a basic rectangular form. The cover upper section 29 and the combustion chamber wall 23 are configured as thicker in the region of the connection between these two components, in other words, in the region of the projection 33 and/or the retaining indentation 34, in order to increase stability against the combustion chamber interior 24. The cover upper section 28 has a contact surface 36 in the thicker or reinforced region 35, on which an inner liner edge 37 of the cover liner 30 lies. The inner liner edge 37 is configured adjacent to a major liner surface 38, forming one piece with said surface and offset from this outwards. A liner edge 41 of the liner element 25 is similarly adjacent to a contact surface 39 of a reinforced or thickened region 40 of the combustion chamber wall 23.

The manhole cover 28 is supported against the combustion chamber exterior 42 by means of a fixing device (not shown). Both the cover liner 30 and the liner element are supported against the combustion chamber interior by means of a fixing element designed as a U-rail. A first side of the U 44 thereby rests on the inner liner edge 37 of the manhole cover 27 and a second side of the U 45 rests on the liner edge 41 of the liner element 31. The sides of the U 44, 57 are also referred to as parts of the fixing element. A total of only two fixing elements 43 are required to support the manhole cover 27 against the combustion chamber interior 24. The fixing elements 43 are attached to this using screws, which are inserted into the reinforced region 40 of the combustion chamber wall 23.

The screws 46 are screwed into the combustion chamber wall 23 from the combustion chamber interior 24. Additional fixing of the liner elements 31 is not necessary in the reinforced region 40. The U-shaped fixing element 43 attached to the combustion chamber wall 23 with the screws 46 is sufficient both to hold the liner element 25 against the combustion chamber wall 23, and to support the cover liner 30 against the combustion chamber interior 24. The liners 25, 30 are sealed by means of the fixing element 43. The escape of cooling air in the

region of the fixing element 43 is excluded. If cooling air were to escape from the wall cooling chamber 26 or the inner cooling chamber 31 at the inner liner edge 37 or at the liner edge 41, this escaping cooling air would be prevented by the U-shaped fixing element 43 from flowing into the combustion chamber interior 24. However this cooling air, retained by the U-shaped fixing element 43, can flow unhindered along the fixing element 43 configured as a rail to the burners 10.

Removal of the fixing element 43 or loosening of the screws 46 is not necessary in order to remove the manhole cover 28 from the manhole 27. This is enabled by the latch-type configuration with which the fixing elements 43 support the liner elements 25 and the cover liner 30 against the combustion chamber interior 24. With the combustion chamber 4 sealed using the manhole cover 28, the fixing element 43 bridges the intermediate chamber between the inner liner edge 37 of the manhole cover 27 and the liner edge 41 of the inner liner element 31, so that the hot operating medium M does not reach the combustion chamber wall 23 or the cover upper section 29 from the combustion chamber interior 24. The combustion chamber 4 is thus completely lined, including the manhole 28.